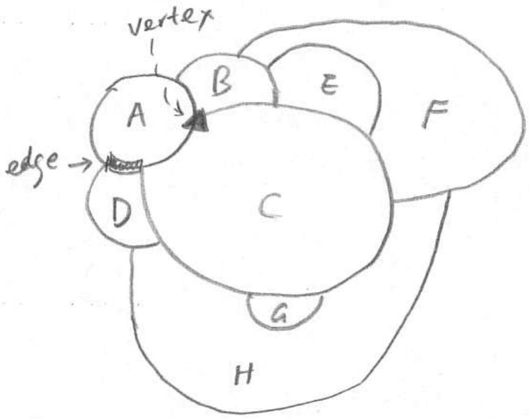
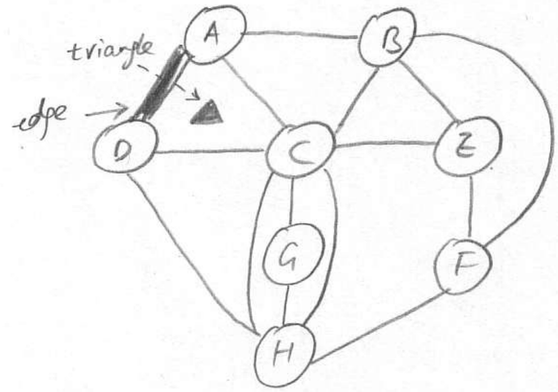
Given regions/boundaries:

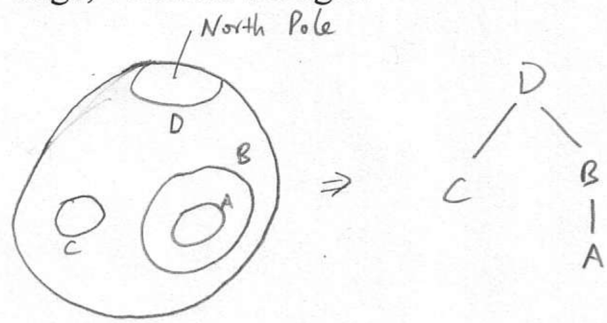


Topology Diagram:



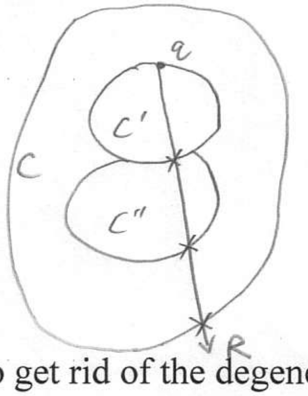
Or we can do dual graph mapping: edge – edge, vertex to triangle.

If we store the topology by half edges, we can use cycle inclusion tree. Note that this tree only works for 2D plane and sphere, not for arbitrary surfaces. For a sphere, we let North Pole be the infinite point:



The algorithm to create the cycle inclusion tree:

1. Pick some point q on C'
2. Shoot a ray R from q
3. If R intersects cycle C old number of times, then q is in the interior of C.

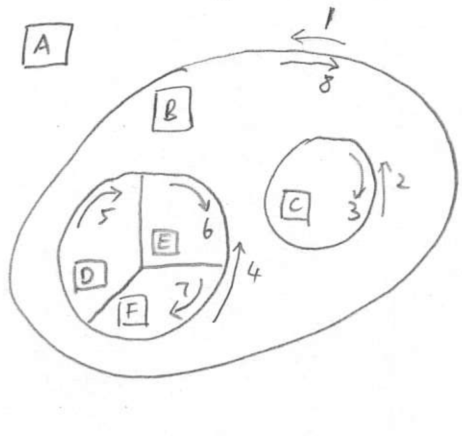


e.g., to classify C' from C and C' from C'', we pick q and shoot the ray R, by counting the intersection number we see: C' in C but C' not in C''.

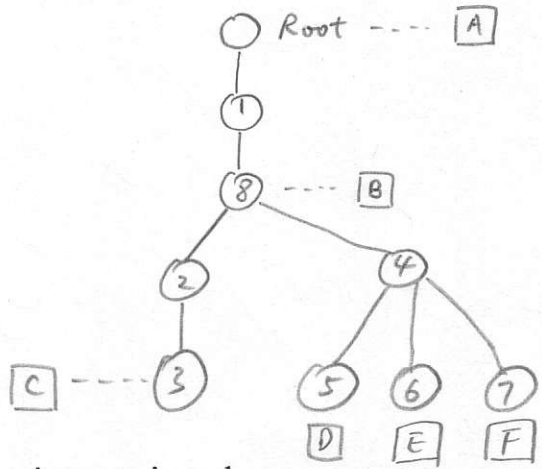
To get rid of the degenerate cases when ray intersects of vertices, we can shoot some secondary rays by jittering.

Note: We assume that we know all half edge loops in advance. If not, we have to create them by ourselves.

Given an image:

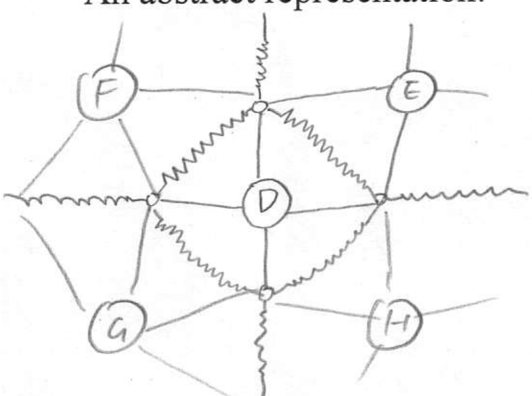


Containment Tree:



Anti-clockwise outer loops have no regions assigned.

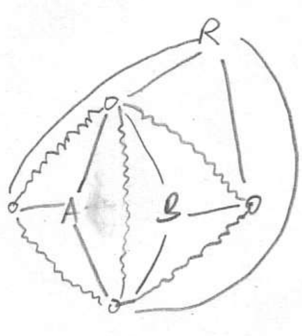
An abstract representation:

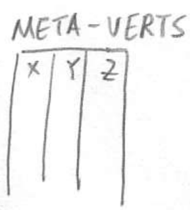


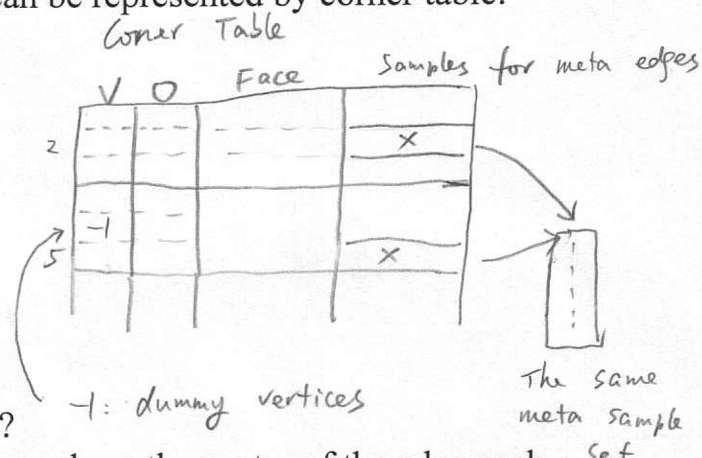
Meta-vertices – the vertices where 3 or more regions meet (∘)

Meta-Edges – sample manifold vertices

For each face (region), we assign a dummy vertex, and then we connect meta-vertices with dummy vertices by dummy edges. This forms a watertight, simple triangle mesh which can be represented by corner table:







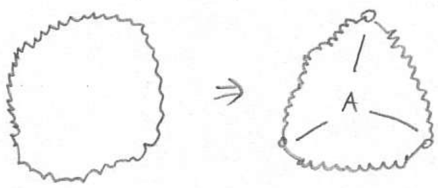
How to simplify samples on meta-edges?

One way is to predict the middle sample as the center of the edge each time… divide and conquer.

Or any old curve predictors discussed before.

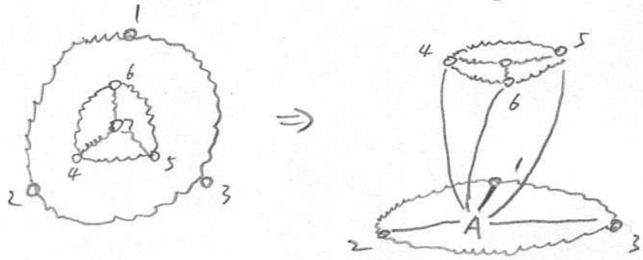
Before we assume that the resulting triangle mesh is simple, however…

Case 1: A single region

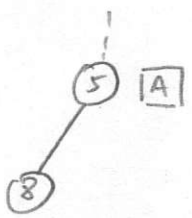


Solution:
Add three virtual meta-vertices so that each loop has at least 3 meta-vertices

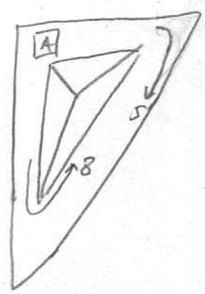
Case 2: Holes – Some region A is not simple connected.



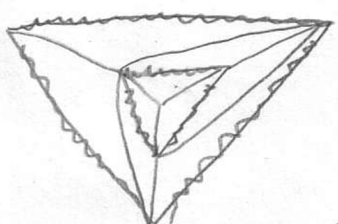
Solution 1:
Keep doing the dummy method as before, which will end up with non-manifold dummy vertices.
Be careful with EDGEBREAKER.



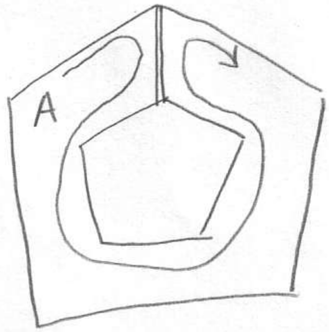
Containment tree



Connect both meta-vertices on 5 and 8 to dummy vertex for A.



Solution 2:
Just triangulate the region A topologically.



Solution 3:
Make a bridge – virtually break the closed region A